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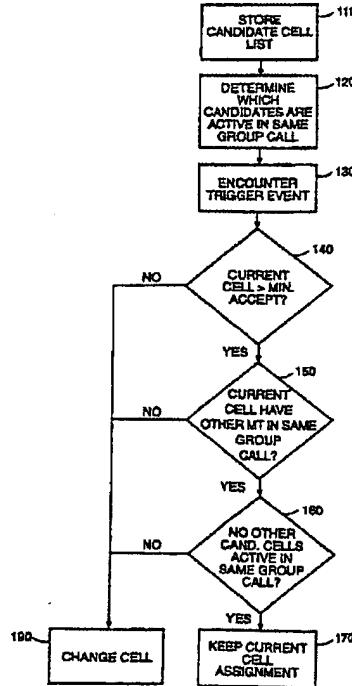
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(54) Title: IMPROVED CELL ASSIGNMENT METHOD DURING GROUP CALLS



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(57) Abstract: A cell assignment process strives to minimize the number of cells assigned to mobile terminals involved in any given group call session in both circuit-switched and packet-data environments. In one embodiment, when a cell assignment trigger event is encountered during a group call, the decision whether to change cells or not is based at least in part upon whether the relevant cell is already participating in that group call session with another mobile terminal or not.

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If so, the cell assignment process preferentially selects such a cell for switching to or avoids changing cell assignment if already assigned there. In another embodiment other cells involved in the group call session are actively sought out and the cell assignments of the mobile terminals involved in the group call session are changed to those cells, even when the signal quality may be acceptable in the current cell. The mobile terminals involved in group call sessions may optionally be given preferential priority when switching cells so as to help minimize disruption to the group call session. Thus, the mobile terminals involved in the group call session are gradually urged toward congregating in the fewest possible cells under the circumstances. Accordingly, the present invention helps provide better service with less of a system capacity penalty for group call sessions.

IMPROVED CELL ASSIGNMENT METHOD DURING GROUP CALLS

Background of the Invention

The present invention relates generally to the assignment of wireless communications mobile terminals to particular cells, and more particularly to the 5 assignment of mobile terminals to particular cells during group calls.

Wireless communications mobile terminals, such as cellular phones and the like, provide a wide variety of services. One increasingly popular service is so-called conference or group call service, wherein a plurality of users having different terminals (mobile or otherwise) are connected together and able to 10 transmit and receive to all of the other active members of a user group. To implement group call functionality in wireless communications system, a user group identification (UGID) code is typically assigned to each of a number of different subsets of mobile terminals. See, for example application serial number 09/192,185, entitled "User Group Indication and Status Change In Radio- 15 communications Systems," which is incorporated herein by reference.

From a system point of view, one advantage of group calls is that multiple mobile terminals may be able to share a single downlink traffic channel within a given cell, rather than having to have separate downlink traffic channels assigned for each mobile terminal. Further, multiple mobile terminals within a given cell 20 involved in a group call may also be able to share a single uplink traffic channel with some technologies. Focusing on just the downlink channel for simplicity of illustration, assume five mobile terminals (MT₁ - MT₅) are active in the group call and present in the same cell (C₁) and two other mobile terminals (MT₆ - MT₇) are

active in the same group call in another cell (C₂). All the mobile terminals in one cell (e.g., C₁ or C₂) are typically able to share a single downlink traffic channel assigned to the group call session, rather than having to have separate downlink traffic channels assigned to each mobile terminal. This may result in only two 5 traffic channels being used -- one in each cell -- rather than seven different traffic channels. From a system point of view, the five channels not used may be assigned to other tasks, thereby allowing for greater overall system capacity utilization.

From time to time during a group call session, a mobile terminal may move 10 from one cell's geographic area to another cell's geographic area and/or the signal quality in a given cell may degrade to a point approaching unacceptable levels. In either case, it may be necessary for the mobile terminal to be assigned to a different cell in order to maintain acceptable performance. That is, the mobile terminal may need to change from communicating with the wireless 15 communications system via base station X to communicating with the wireless communications system via base station Y (or the equivalent in satellite based systems). In circuit switch systems, this process is typically referred to as "handoff," and is typically controlled by the wireless communications system in a manner well known in the art. In packet data systems, this process is typically 20 referred to as "cell reselection," and is typically controlled by the mobile terminal in a manner likewise well known in the art.

If the result of the change in cell assignment is that the mobile terminal is assigned to a cell not otherwise actively engaged in the group call, the new cell

must allocate a traffic channel under its control to the group call so that the "newly arrived" mobile terminal may continue to participate in the group call. Thus, in the example given above, if mobile terminal MT₃ is moving out of cell C₁, it will eventually need to have its cell assignment changed via what is known

5 generically as a cell assignment change procedure. If the result is MT₃ being assigned to a new cell C₃, then cell C₃ must allocate a traffic channel to MT₃ so that MT₃ can remain active in the group call. In such a situation, the total number of traffic channels needed for the group call session would increase from two to three. Because more channels are being consumed by the group call, the overall

10 capacity of the wireless communications system is reduced. If, on the other hand, mobile terminal MT₃ is instead assigned to cell C₂, where MT₆ and MT₇ are already present and active in the group call, then MT₃ may simply join MT₆ and MT₇ on their shared channel. In this scenario, the number of channels used by the group call does not change, and the change in cell assignment for MT₃ results

15 in essentially no net loss in capacity to the wireless communications system.

From the above, it is clear that minimizing the number of cells that mobile terminals involved in a given group call are assigned to helps preserve the overall capacity of a wireless communications system. However, the existing cell assignment procedures do not take group call participation into account when

20 assigning a mobile terminal to a cell. Thus, there is a need for an improved cell assignment procedure that recognizes that mobile terminals that are active in a group call should be kept in the same cells to the extent reasonably possible.

Summary of the Invention

The cell assignment process of the present invention strives to minimize the number of cells assigned to mobile terminals involved in any given group call session. When a cell assignment trigger event, also known as a handoff trigger event or a cell reselection trigger event, is encountered during a group call, the decision whether to change cells or not is based at least in part upon whether the relevant cell is already participating in that group call session with another mobile terminal. If so, the cell assignment process preferentially selects such a cell for switching to, or avoids changing cell assignment if already assigned there.

10. In one embodiment, the present invention preferentially selects cells already participating in the group call session when changing cell assignments. In other embodiments, the present invention avoids reassigning the mobile terminal in response to encountering a trigger event when several conditions are met. These conditions include, generally, the current cell both having at least 15 minimally acceptable performance and currently supporting at least one other mobile terminal of the same group call session, and also that no candidate cells are currently supporting the same group call session. If the three conditions are met, the cell assignment of the mobile terminal is not changed; otherwise the cell assignment of the mobile terminal is changed. In addition, other embodiments of 20 the present invention actively seek out other cells involved in the group call session and seek to change the cell assignments of the mobile terminals involved in the group call session to those cells, even when the signal quality may be acceptable in the current cell. Thus, the mobile terminals involved in the group

call session are gradually urged toward congregating in the fewest possible cells under the circumstances.

The decision whether to make the new cell assignment may be made in the mobile terminal or in the wireless communications system with the present 5 invention. Further, the present approach functions in both circuit-switched and packet-data environments. Additionally, one optional aspect of the present invention is to give mobile terminals involved in group call sessions preferential priority when switching cells so as to help minimize disruption to the group call session. Thus, the present invention helps provide better service with less of a 10 system capacity penalty for group call sessions.

Brief Description of the Drawings

FIGURE 1 is a representation of one embodiment of a wireless communications system wherein the present invention may be practiced.

15 **FIGURE 2** is a simplified flow chart showing the overall process flow of one embodiment of the present invention.

FIGURE 3 is a simplified flow chart showing the overall process flow of another embodiment of the present invention.

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Detailed Description of the Invention

In the following description, like reference characters designate like or corresponding parts throughout the several views. Referring now to the drawings, the improved cell assignment method of the present invention is described. Cell

assignment according to the present invention is useful in wireless communications systems, such as that shown schematically in Figure 1. The wireless communications system, which is indicated generally by the numeral 10, includes a plurality of base stations 12, which are connected via a mobile services switching center (MSC) 14 to a terrestrial communications network such as the Public Switched Telephone Network (PSTN) 16. Each base station 12 is located in and provides service to a geographic region referred to as a cell. In general, there is one base station 12 for each cell within a given system. Within each cell, there may be a plurality of mobile terminals 20 that communicate via a radio link with the base station 12. The base station 12 allows the user of the mobile terminal 20 to communicate with other mobile terminals 20, or with users connected to the PSTN 18. The MSC 14 routes calls to and from the mobile terminal 20 through the appropriate base station 12. Information concerning the location and activity status of the mobile terminal 20 may be stored in a Home Location Register (not shown) and/or a Visitor Location Register (not shown) connected to the MSC 14 in a manner well known in the art. A group call services server (GCS) 18 is connected to the MSCs 14 and PSTN 16 for managing the call setup activities for group calling features in a manner well known in the art. When the wireless communications system 10 receives a group call request, the request is forwarded to the GCS 18. The other components of the system 10 cooperate with the GCS 18 to facilitate the group call.

It is worth noting that a different system architecture is often used for packet data sessions, such as that used in GPRS and Mobile IP. As such, there

may be no involvement from the MSC 14. In essence, the base station 12 is connected to a packet data node, and then to the public packet data network through additional nodes to reach the internet. Furthermore, the concepts of the present invention are applicable to all current and future wireless communication systems, including cdma2000 and WCDMA.

Mobile terminals 20 may communicate with the wireless communications system 10 via what are essentially two types of cellular communication techniques, circuit-switched and packet-switched. A circuit-switched connection is a circuit connection that is established and maintained, usually on demand, between two or more stations to allow the exclusive use of the circuit until the connection is released. A packet-switched connection is a logical connection that is established between two or more stations to allow the routing and transfer of data in the form of packets. The channel is occupied during the transmission of a packet only. Upon completion of the transmission, the channel is made available for the transmission of other packets for the same or other stations. Channel selection procedures, and thus cell assignment procedures, typically vary depending on whether circuit-switched or packet-switched connections are used.

When a mobile terminal 20 is actively involved in a circuit-switched group call session, the present invention may follow the process flow shown in Figure 2. A list of candidate cells for reassignment is stored (box 110). This list may be what is known as a Neighbor List, or the list may take other forms. The intention of the candidate list is to provide a subset of all possible cells that includes the most likely cells that the mobile terminal 20 should be assigned to. Typically, the

wireless communications system 10 stores this list and also broadcasts the list to mobile terminals 20 for storage in the mobile terminals 20. The candidate list may be established before or during the group call session and may change during the group call session, particularly as the mobile terminal 20 moves from one cell to 5 another. The cells on the candidate list are examined to see if they are currently participating in the group call session (box 120). For instance, the wireless communications system 10 may simply keep track of all cells currently involved in the group call session and compare the candidate list against this active list. Alternatively, the mobile terminal 20 may monitor the candidate cells, looking for 10 signs of activity in the group call session, such as the presence of the appropriate UGID in a broadcast message. Further still, the wireless communications system 10 may track the cells currently involved in the group call session and transmit this information to the mobile terminal 20, such as in a message directed to all 15 mobile terminals 20 active in the group call session, or in a message directed to only that mobile terminal 20. Obviously, the list of active cells should be updated frequently to insure that the latest information is being used.

The main portion of the Figure 2 process begins when a trigger event is encountered (box 130). A trigger event is an event that suggests that consideration should be given to the mobile terminal 20 changing cell assignment. 20 For instance, a mobile terminal 20 may note that the signal quality in a given cell is degrading to a point approaching unacceptable levels, such as might be encountered when a mobile terminal 20 approaches a cell boundary. The trigger event may be encountered by the mobile terminal 20 or by the wireless

communications system 10. If the trigger event is encountered by the mobile terminal 20, the mobile terminal 20 may communicate this situation to the wireless communications system 10, and vice-versa. Further, it should be noted that box 130 is shown in Figure 2 as occurring after boxes 110 and 120 for ease of 5 description, but this is not required and box 130 may occur before box 120 or box 110.

In response to the trigger event, the cell assignment for the mobile terminal 20 is examined and changed if appropriate. In one embodiment, shown in Figure 2, the cell assignment is changed (box 190) unless three conditions are met.

- 10 First, the current cell must have at least minimally acceptable performance (box 140). Because the trigger event is typically encountered when the signal performance is degrading, but still above the minimally acceptable level by some guard amount, it is possible that the signal performance of the current cell will be low enough to constitute a trigger event, but high enough to continue with the 15 current cell for some time. Next, the current cell must be currently supporting at least one other mobile terminal 20 in the same group call session (box 150). Finally, no candidate cells of the candidate list (other than the current cell if it is included in the candidate list) must be currently supporting the same group call session (box 160). If the three conditions are met, the cell assignment of the 20 mobile terminal 20 is not changed (box 170); otherwise the cell assignment of the mobile terminal 20 is changed (box 190).

Typically, the wireless communications system 10 is the entity performing the analysis of boxes 140-160; thus, the wireless communications system 10

typically communicates the change in cell assignment to the mobile terminal 20 by transmitting a cell change instruction to the mobile terminal 20 in a manner well known in the art and appropriate for the protocol being used. For circuit-switched call sessions, this type of instruction is typically referred to as a "handoff" 5 message. The mobile terminal 20 then establishes communications in the new cell as in a manner well known in the art.

It is preferred that the mobile terminal 20 receive preferential treatment from the new cell when changing cell assignments during a group call session. That is, the being-switched mobile terminal 20 should be given greater than 10 normal priority in the "new" cell. For example, if cells typically have a queue for new-to-them calls, the being-switched mobile terminal 20 may be given a preferential position in that queue, or be able to bypass that queue all together. Alternatively, if cells typically reserve a certain number of channels for special 15 purposes, such as for emergency ("911") calls, while allowing the remaining channels to be freely assigned, the being-switched mobile terminal 20 may be given one of the reserved channels, rather than waiting for one of the regular channels.

Preferably, when the mobile terminal 20 changes cells (box 190), it changes to a cell already participating in that group call session. For instance, if 20 there are several candidate cells that would be at least acceptable, the mobile terminal 20 should be assigned preferentially to a cell already participating in that group call session with another mobile terminal 20. In essence, the candidate

cells active in the group call session are given more "weight," or stated another way are more "attractive."

It should be noted that the process outlined immediately above results in cell re-assignments being avoided for mobile terminals 20 involved in group call sessions, except when necessary. Thus, the process may be thought of as a cell re-assignment avoidance scheme where the attractiveness of a cell to a mobile involved in a group call session is based at least in part upon whether that cell is already participating in that group call session with another mobile terminal 20. If so, the cell is more attractive to that mobile terminal 20 and more attractive cells are more likely to be switched into (or retain) mobile terminals 20 involved in that group call session.

When a mobile terminal 20 is actively involved in a packet-data group call session, the present invention also follows a process flow similar to that shown in Figure 2. However, in packet-data call sessions, it is much more likely that the mobile terminal 20 will retain control of cell assignments rather than the wireless communications system 10. Because of this, the mobile terminal 20 typically receives the listing of which candidate cells are active in the group call in a message from the wireless communications system 10. This message may take a wide variety of forms, including a broadcast message containing a simple bit map to be compared against a Neighbor List, indicating which cells are active in the group call session. Alternatively, the message may be an addressed message directed at just that mobile terminal 20 or at several mobile terminals 20, such as all those active in the group call session. Likewise, the wireless

communications system 10 may send a message that includes an adjustment to a bias weighting parameter used by a cell assignment routine resident on the mobile terminal 20 that deters changes in cell assignment. For instance, in ANSI-136 systems, a suitable bias weighting parameter is the variable known as 5 SERV_SS. In such a manner, the mobile terminal 20 may retain control of the cell assignment process, but be influenced by the wireless communications system 10 to preferentially switch into, or remain with, cells involved in that group call session. Of course, in some packet-data situations, the wireless communications system 10 may control the cell assignment process. Either way, 10 the improved cell assignment process of the present invention tends to minimize the number of cells assigned to mobile terminals 20 involved in any given packet-data group call session.

In some embodiments, the cell assignments mobile terminals 20 involved in a group call session are changed, even when the signal quality may be 15 acceptable in the current cell. As shown in Figure 3, this active congregation process shares many steps with the process of Figure 2; differing mainly in that no "trigger event" is required to initiate the cell assignment analysis procedure. Instead, once the mobile terminal 20 becomes involved with the group call session (box 115), an active search process begins. Armed with knowledge of 20 which candidate cells are active in the same group call (box 120), an examination is made of the current cell. If the current cell is supporting another mobile terminal active in the same group call, the current cell assignment is kept (box 170). If not, the process looks to see if any other candidate cells of the candidate

list (other than the current cell if it is included in the candidate list) are currently supporting the same group call session (box 160). If not, then the current cell assignment is kept (box 170). If so, the signal quality of the candidate cells that are otherwise supporting the same group call are examined. If any one of such 5 cells have better than at least minimally acceptable signal performance (box 180), then the cell assignment is changed to one of such cells (box 190). If not, the current cell assignment is kept (box 170). Of course, the cell assignment of box 190 may preferably be to the cell otherwise supporting the same group call that has the best signal quality, or to the one having the most available capacity, or 10 the like. In addition, some level above the minimally acceptable level of signal quality may be used as the decision criterion in box 180.

Because no degradation in signal quality is required to change the cell assignment under the process of Figure 3, this active congregation method may result in mobile terminals active in group call sessions changing cell assignments 15 even when the signal quality, and all other aspects, of the current cell are otherwise good, except for absence of other mobile terminals involved in the group call session. Thus, a mobile terminal active in a group call session may change from one "good" cell to another equally "good" cell for no other reason than to congregate with other mobile terminals also involved in the group call 20 session. In addition, under some circumstances, a mobile terminal active in a group call session may change from one "good" cell to a lower quality, even barely marginal, cell for the same reason. Such an approach may be particularly suited to situations involving an overlay/underlay or hierarchical cell layouts. Of

course, suitable anti-hysteresis measures should be employed, such as minimum time delays between cell assignment changes, to avoid tying up resources by having mobile terminals chase each other from cell to cell in an endless loop.

While not required, the both the cell re-assignment avoidance aspect and 5 the active congregation aspect are preferably practiced simultaneously. In this fashion, the improved cell assignment process of the present invention may most quickly minimize the number of cells assigned to mobile terminals 20 involved in any given group call session.

The present invention may, of course, be carried out in other specific ways 10 than those herein set forth without departing from the spirit and essential characteristics of the invention. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive, and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.

Claims

What is Claimed is:

1. A method of controlling cell assignment of a wireless communications mobile terminal during a group call session, comprising:

5 storing a list of candidate cells;

determining whether at least one of said candidate cells is

participating in said group call session;

selecting a new cell from said list of candidate cells based on

whether said candidate cells, including said at least one of said

10 candidate cells, are participating in said group call session in response to a cell selection trigger event during said group call session.

2. The method of claim 1 wherein said determining whether said at least one of said candidate cells is participating in said group call includes determining which, if any, of said candidate cells is participating in said group call.

3. The method of claim 1 wherein said selecting a new cell from said list of candidate cells based on whether said candidate cells are participating in said group call session in response to a cell selection trigger event during said group call session is performed by said mobile terminal.

20 4. The method of claim 1 wherein selecting a new cell from said list of candidate cells based on whether said candidate cells are participating in said group call session in response to a cell selection trigger event during said group call session is performed by a wireless communications system in communication

with said mobile terminal and further including said mobile terminal changing cell selection based on instructions received from said wireless communications system.

5. The method of claim 1 wherein said mobile terminal communicates with at least one wireless communications system during said group call session and wherein selecting a new cell from said list of candidate cells based on whether said candidate cells are participating in said group call session in response to a cell selection trigger event during said group call session is performed by said wireless communications system and further including sending said mobile terminal an indication of which of said candidate cells are participating in said group call session by said wireless communications system.
10. The method of claim 5 wherein said sending said mobile terminal an indication of which of said candidate cells are participating in said group call session by said wireless communications system is performed via a broadcast message.
15. The method of claim 5 wherein said sending said mobile terminal an indication of which of said candidate cells are participating in said group call session by said wireless communications system is performed via a broadcast message via an addressed message.
20. The method of claim 7 wherein said sending said mobile terminal an indication of which of said candidate cells are participating in said group call session by said wireless communications system is performed via a broadcast message to all mobile terminals active in said group call.

9. A method of controlling cell assignment of a wireless communications mobile terminal during an active packet data group call session, comprising:

storing a list of candidate cells including a current cell;

receiving, at the mobile terminal, said list of candidate cells from a

5 corresponding wireless communications system;

determining whether at least one of said candidate cells is

participating in said group call session;

said mobile terminal determining whether to stay with said current

cell or to select a new cell in response to a cell selection trigger

10 event during said group call session, said mobile terminal

determining to remain with the current cell if:

i) said current cell provides at least minimally acceptable signal quality; and

ii) said current cell is participating in said group call session

15 with another mobile terminal assigned to said current cell; and

iii) no acceptable candidate cells, not including said current cell, are participating in said group call session.

10. The method of claim 9 wherein said receiving, at the mobile terminal,
20 said list of candidate cells from the corresponding wireless communications system includes said mobile terminal receiving a message addressed to all active group members in said group call session.

11. The method of claim 10 further including said wireless communications system broadcasting a neighbor list of candidate cells and wherein said message addressed to all active group members in said group call session includes a bit map indicating which of said candidate cells on said neighbor list are active in said group call session.
12. The method of claim 9 further including said wireless communications system broadcasting a neighbor list of candidate cells on a broadcast control channel and wherein said broadcast control channel further includes information indicating which of said candidate cells on said neighbor list are active in said group call session.
13. The method of claim 9 wherein said mobile terminal determining whether to stay with said current cell or to select a new cell in response to a cell selection trigger event during said group call session is based on an algorithm that includes a bias weighting factor parameter and further including said wireless communications system transmitting a message revising said bias weighting factor parameter so as to deter changes in cell selection.
14. The method of claim 13 wherein said wireless communications system transmitting a message revising said bias weighting factor parameter so as to deter changes in cell selection is performed by transmitting a broadcast message.
15. The method of claim 13 wherein said wireless communications system transmitting a message revising said bias weighting factor parameter so as to deter changes in cell selection is performed by transmitting a message addressed to all active group members in said group call session.

16. The method of claim 9 wherein said mobile terminal determining whether to stay with said current cell or to select a new cell in response to a cell selection trigger event during said group call session is based on an algorithm that includes a bias weighting factor parameter and further including

5 preprogramming said bias weighting factor parameter into said mobile terminal so as to deter changes in cell selection into cells not actively supporting said group call session.

17. A method of controlling cell assignment of a wireless communications mobile terminal by a wireless communications system during an active packet data group call session, comprising:

storing a list of candidate cells including a current cell;

determining whether at least one of said candidate cells other than said current cell is participating in said group call session;

receiving notification at the corresponding wireless communications system that the mobile terminal has encountered a cell selection trigger event during said group call session;

15 thereafter, said wireless communications system determining whether said mobile terminal should stay with the current cell or change in response to said cell selection trigger event, said wireless communications system determining that said mobile

20 terminal should change cells unless:

i) the current cell provides at least minimally acceptable signal quality to said mobile terminal;

ii) the current cell is participating in said group call session with another mobile terminal assigned to said current cell; and

iii) no acceptable candidate cells, not including the current cell, are participating in said group call session;

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said wireless communications system instructing said mobile terminal to change cells if said wireless communications system determines that said mobile terminal should change cells.

18. A method of controlling cell assignment of a wireless communications 10 mobile terminal operating in conjunction with a wireless communications system during an active circuit switched group call, comprising:

storing a list of candidate cells including a current cell at said wireless communications system;

said wireless communications system determining which, if any, of 15 said candidate cells is participating in said group call;

said wireless communications system determining whether said mobile terminal should stay with the current cell or be handed off to another cell in response to a handoff trigger event, said wireless communications system determining that said mobile

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terminal should be handed off to another cell unless:

i) said current cell provides at least minimally acceptable signal quality to said mobile terminal;

ii) said current cell is participating in said group call with
another mobile terminal assigned to said current cell;
and

iii) no acceptable candidate cells, not including said current
5 cell, are participating in said group call;

said wireless communications system instructing said mobile
terminal to change cells if said wireless communications system
determines that said mobile terminal should be handed off to
another cell.

10 19. A method of controlling cell assignment of a wireless communications
mobile terminal operating in conjunction with a wireless communications system
during an active circuit switched group call, comprising:

communicating with said mobile terminal via a first cell during said
group call;

15 assigning a greater than normal priority to said mobile terminal and
handing off said mobile terminal to a second cell with said
greater than normal priority in response to a handoff trigger
event during said group call.

20 20. The method of claim 19 further including said second cell maintaining
a queue of channel assignment requests and further including assigning a
preferential position in said queue to said handed-off group call.

21. The method of claim 20 further including said second cell maintaining a queue of channel assignment requests and further including assigning the most preferential position in said queue to said handed-off group call.

22. The method of claim 19 further including said second cell maintaining 5 a queue of channel assignment requests and further including allowing said handed-off group call to bypass said queue.

23. The method of claim 19 wherein said second cell includes normal and reserve channels and further including allocating said handed-off group call one of said reserve channels.

10 24. A method of controlling cell assignment of a wireless communications mobile terminal participating in a group call session, comprising:

assigning said mobile terminal to a first cell;

storing a list of candidate cells including a second cell;

determining if said second cell is participating in said group call

15 session;

selectively changing the cell assignment of said mobile terminal

from said first cell to said second cell based on participation of

said first and second cells in said group call session.

25. The method of claim 24 wherein said determining if said second cell is 20 participating in said group call session includes determining which, if any, of said candidate cells is participating in said group call.

26. The method of claim 24 wherein said selectively changing the cell assignment of said mobile terminal includes changing the cell assignment of said mobile terminal from said first cell to said second cell if:

5 said first cell is not participating in said group call session with
 another mobile terminal assigned to said first cell;
 said second cell is participating in said group call session; and
 said second cell provides at least minimally acceptable signal quality
 to said mobile terminal.

27. The method of claim 24 wherein said selectively changing the cell assignment of said mobile terminal includes changing the cell assignment of said mobile terminal from said first cell to said second cell if:

10 said first cell is not participating in said group call session with
 another mobile terminal assigned to said first cell;
 said second cell is participating in said group call session; and
 said second cell provides signal quality of better than a
 predetermined level to said mobile terminal.

15 28. The method of claim 24 wherein said mobile terminal is a first mobile terminal and further including assigning a second mobile terminal to said second cell prior to said determining if said second cell is participating in said group call session and wherein said selectively changing the cell assignment of said mobile terminal includes changing the cell assignment of said mobile terminal from said first cell to said second cell because said second mobile terminal is participating in said group call session in said second cell.

29. The method of claim 24 wherein said first cell belongs to a wireless communications system and wherein said determining if said second cell is participating in said group call session is performed by said wireless communications system.

5 30. The method of claim 24 wherein selectively changing the cell assignment of said mobile terminal from said first cell to said second cell based on participation of said first and second cells in said group call session includes said mobile terminal controlling said selectively changing the cell assignment of said mobile terminal from said first cell to said second cell based on participation 10 of said first and second cells in said group call session.

31. The method of claim 29 wherein selectively changing the cell assignment of said mobile terminal from said first cell to said second cell based on participation of said first and second cells in said group call session includes said wireless communications system controlling said selectively changing the cell 15 assignment of said mobile terminal from said first cell to said second cell based on participation of said first and second cells in said group call session

32. A method of minimizing the number of cells supporting a plurality of mobile terminals participating in a group call session, said method comprising controlling changes in cell assignment of said mobile terminals at least in part 20 based upon the participation of said cells in said group call session.

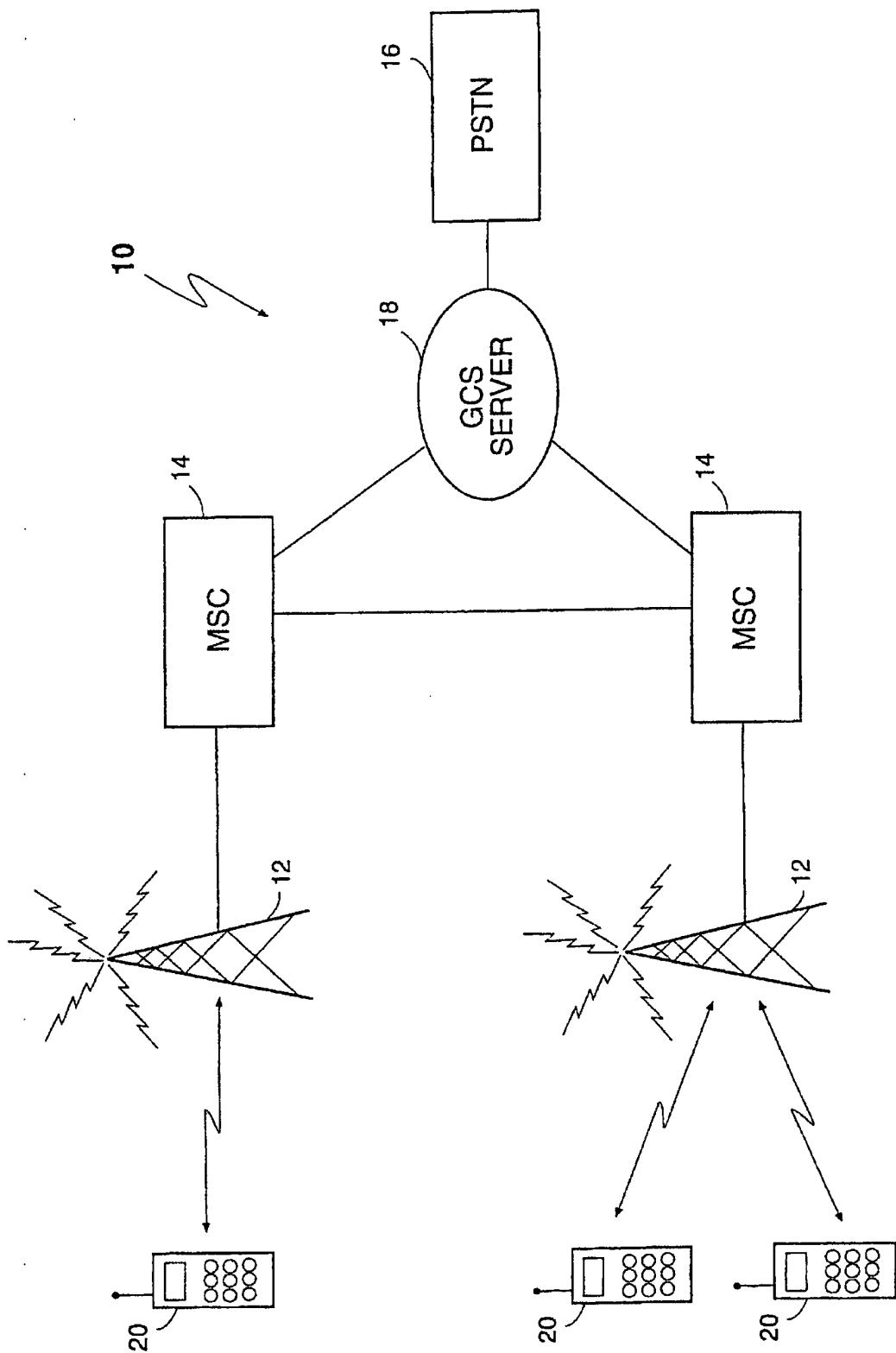
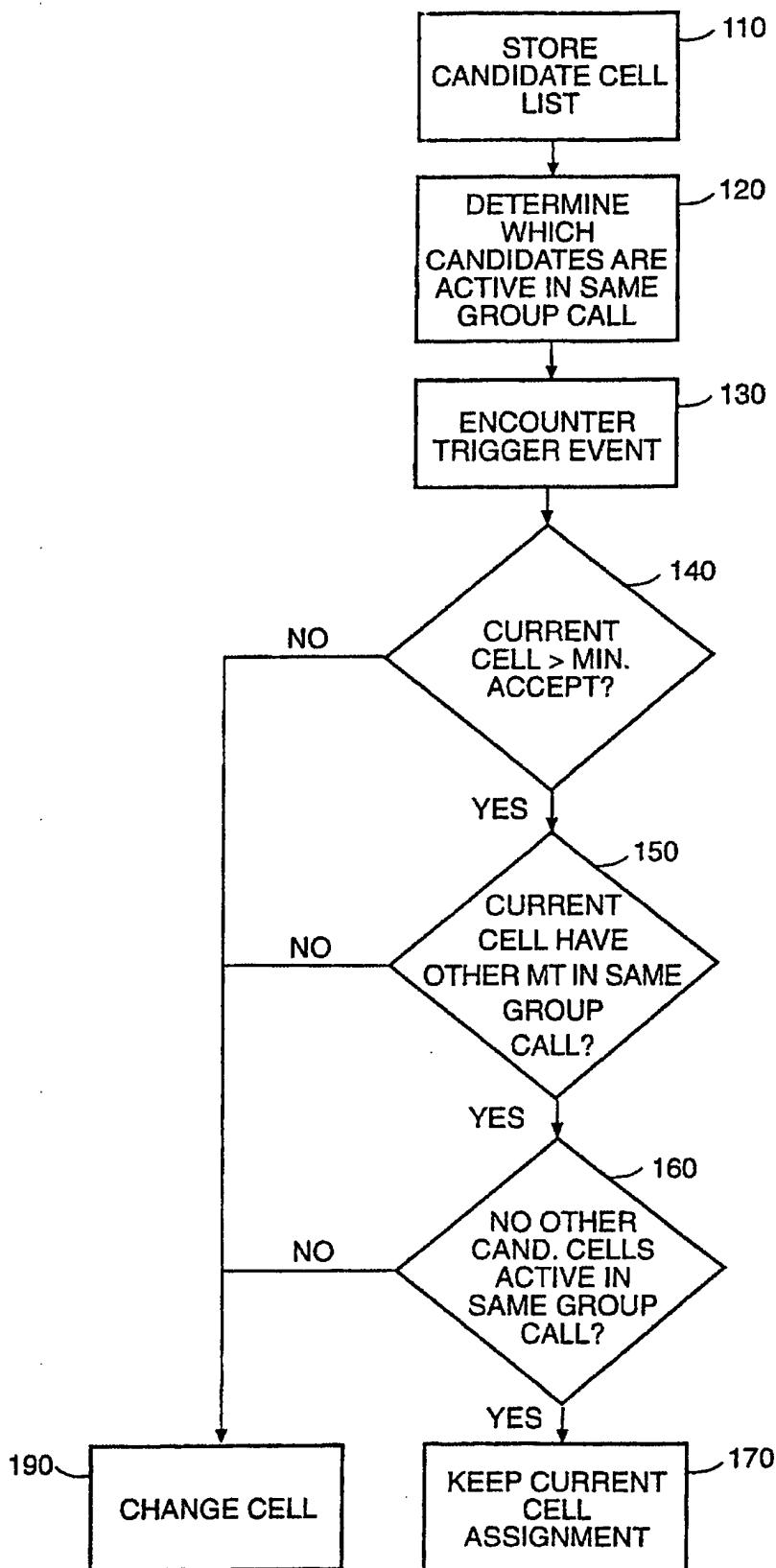


FIG. 1



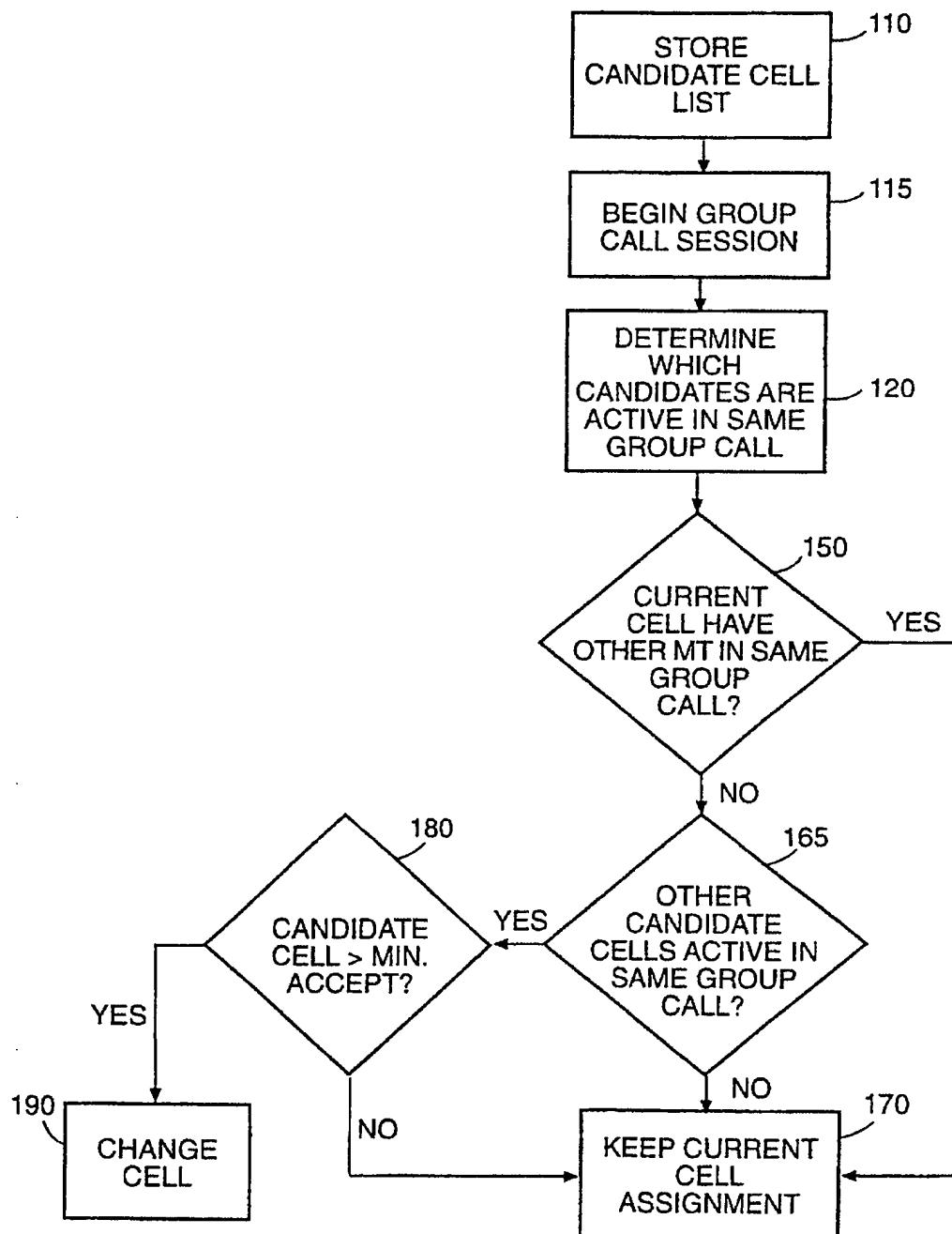


FIG. 3

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(21) International Application Number: PCT/US00/31409 (81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

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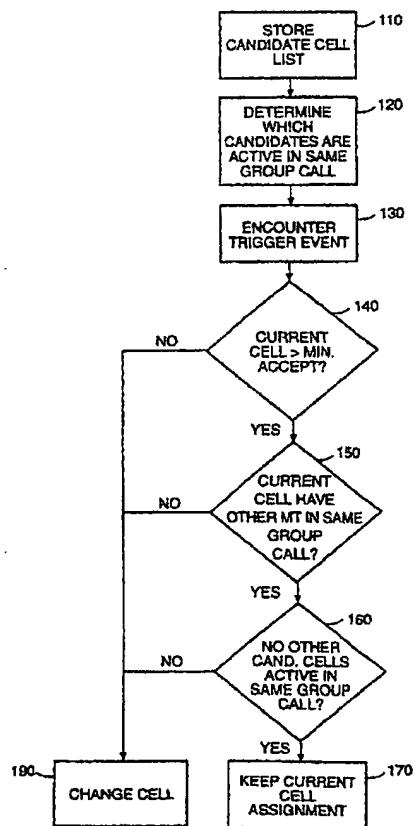
(30) Priority Data: 09/467,711 20 December 1999 (20.12.1999) US

(71) Applicant: ERICSSON INC. [US/US]: 7001 Development Drive, Research Triangle Park, NC 27709 (US).

(72) Inventor: RAITH, Alex, Krister: Apartment 1108, 7555 Charman Drive, San Diego, CA 92122 (US). Published: — with international search report

{Continued on next page}

(54) Title: IMPROVED CELL ASSIGNMENT METHOD DURING GROUP CALLS



(57) Abstract: A cell assignment process strives to minimize the number of cells assigned to mobile terminals involved in any given group call session in both circuit-switched and packet-data environments. In one embodiment, when a cell assignment trigger event is encountered during a group call, the decision whether to change cells or not is based at least in part upon whether the relevant cell is already participating in that group call session with another mobile terminal or not. If so, the cell assignment process preferentially selects such a cell for switching to or avoids changing cell assignment if already assigned there. In another embodiment other cells involved in the group call session are actively sought out and the cell assignments of the mobile terminals involved in the group call session are changed to those cells, even when the signal quality may be acceptable in the current cell. The mobile terminals involved in group call sessions may optionally be given preferential priority when switching cells so as to help minimize disruption to the group call session. Thus, the mobile terminals involved in the group call session are gradually urged toward congregating in the fewest possible cells under the circumstances. Accordingly, the present invention helps provide better service with less of a system capacity penalty for group call sessions.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 00/31409

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04Q7/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 970 417 A (SUIKKOLA RAUNO ET AL) 19 October 1999 (1999-10-19)	1-8, 24-27, 29-32
A	column 3, line 18 - line 67 column 5, line 50 -column 6, line 58; figures 2,11-13 ---	9,17-19
X	US 5 465 391 A (TOEYRYLAE HANNU) 7 November 1995 (1995-11-07)	1-8
A	column 1, line 25 -column 2, line 23 column 3, line 33 -column 5, line 2; figure 1 ---	9,17-19, 24
X	US 5 852 781 A (AHVENAINEN JOUKO) 22 December 1998 (1998-12-22) column 3, line 27 -column 4, line 23 column 5, line 1 - line 54; figure 2 ---	32
		-/-

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

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- *E* earlier document but published on or after the International filing date
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X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

& document member of the same patent family

Date of the actual completion of the International search

20 July 2001

Date of mailing of the International search report

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Authorized officer

Tsapelis, A

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INTERNATIONAL SEARCH REPORT

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P, X	WO 00 38439 A (ERICSSON INC) 29 June 2000 (2000-06-29) page 5, line 1 -page 6, line 16 page 7, line 17 -page 8, line 25 page 14, line 1 -page 15, line 6 page 16, line 5 -page 25, line 8; figures -----	32

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 00/31409

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
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(22) International Filing Date: 15 November 2000 (15.11.2000) (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

(25) Filing Language: English

(26) Publication Language: English

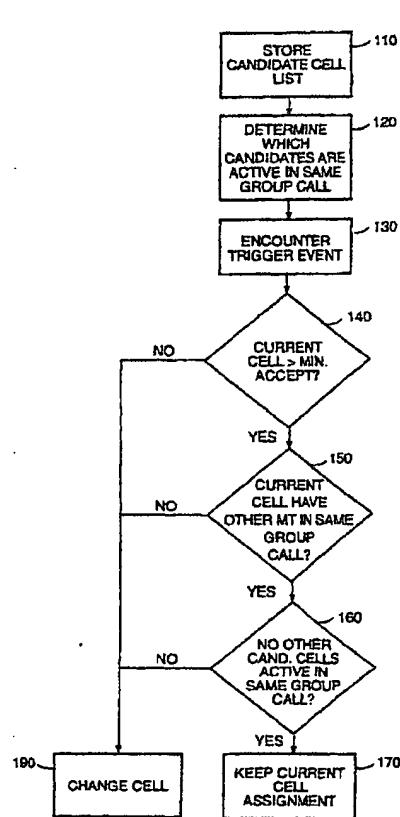
(30) Priority Data: 09/467,711 20 December 1999 (20.12.1999) US

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[Continued on next page]

(54) Title: IMPROVED CELL ASSIGNMENT METHOD DURING GROUP CALLS



(57) Abstract: A cell assignment process strives to minimize the number of cells assigned to mobile terminals involved in any given group call session in both circuit-switched and packet-data environments. In one embodiment, when a cell assignment trigger event is encountered during a group call, the decision whether to change cells or not is based at least in part upon whether the relevant cell is already participating in that group call session with another mobile terminal or not. If so, the cell assignment process preferentially selects such a cell for switching to or avoids changing cell assignment if already assigned there. In another embodiment other cells involved in the group call session are actively sought out and the cell assignments of the mobile terminals involved in the group call session are changed to those cells, even when the signal quality may be acceptable in the current cell. The mobile terminals involved in group call sessions may optionally be given preferential priority when switching cells so as to help minimize disruption to the group call session. Thus, the mobile terminals involved in the group call session are gradually urged toward congregating in the fewest possible cells under the circumstances. Accordingly, the present invention helps provide better service with less of a system capacity penalty for group call sessions.

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— *with amended claims and statement*

(88) **Date of publication of the international search report:**
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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Date of publication of the amended claims and statement:
31 January 2002

AMENDED CLAIMS

[received by the International Bureau on 25 September 2001 (25.09.01);
original claims 1-8 and 32 cancelled; remaining claims unchanged (8 pages)]

1. Cancelled
2. Cancelled
- 5 3. Cancelled
4. Cancelled
5. Cancelled
6. Cancelled
7. Cancelled
- 10 8. Cancelled
9. A method of controlling cell assignment of a wireless communications mobile terminal during an active packet data group call session, comprising:
 - storing a list of candidate cells including a current cell;
 - receiving, at the mobile terminal, said list of candidate cells from a
 - 15 corresponding wireless communications system;
 - determining whether at least one of said candidate cells is
 - participating in said group call session;
 - said mobile terminal determining whether to stay with said current
 - cell or to select a new cell in response to a cell selection trigger
 - 20 event during said group call session, said mobile terminal
 - determining to remain with the current cell if:
 - i) said current cell provides at least minimally acceptable
 - signal quality; and

- ii) said current cell is participating in said group call session with another mobile terminal assigned to said current cell; and
- iii) no acceptable candidate cells, not including said current cell, are participating in said group call session.

5 10. The method of claim 9 wherein said receiving, at the mobile terminal, said list of candidate cells from the corresponding wireless communications system includes said mobile terminal receiving a message addressed to all active group members in said group call session.

10 11. The method of claim 10 further including said wireless communications system broadcasting a neighbor list of candidate cells and wherein said message addressed to all active group members in said group call session includes a bit map indicating which of said candidate cells on said neighbor list are active in said group call session.

15 12. The method of claim 9 further including said wireless communications system broadcasting a neighbor list of candidate cells on a broadcast control channel and wherein said broadcast control channel further includes information indicating which of said candidate cells on said neighbor list are active in said group call session.

20 13. The method of claim 9 wherein said mobile terminal determining whether to stay with said current cell or to select a new cell in response to a cell selection trigger event during said group call session is based on an algorithm that includes a bias weighting factor parameter and further including said wireless

communications system transmitting a message revising said bias weighting factor parameter so as to deter changes in cell selection.

14. The method of claim 13 wherein said wireless communications system transmitting a message revising said bias weighting factor parameter so as to 5 deter changes in cell selection is performed by transmitting a broadcast message.

15. The method of claim 13 wherein said wireless communications system transmitting a message revising said bias weighting factor parameter so as to deter changes in cell selection is performed by transmitting a message addressed to all active group members in said group call session.

10 16. The method of claim 9 wherein said mobile terminal determining whether to stay with said current cell or to select a new cell in response to a cell selection trigger event during said group call session is based on an algorithm that includes a bias weighting factor parameter and further including preprogramming said bias weighting factor parameter into said mobile terminal so as to deter 15 changes in cell selection into cells not actively supporting said group call session.

17. A method of controlling cell assignment of a wireless communications mobile terminal by a wireless communications system during an active packet data group call session, comprising:

20 storing a list of candidate cells including a current cell; determining whether at least one of said candidate cells other than said current cell is participating in said group call session; receiving notification at the corresponding wireless communications system that the mobile terminal has encountered a cell selection trigger event during said group call session;

5

thereafter, said wireless communications system determining whether said mobile terminal should stay with the current cell or change in response to said cell selection trigger event, said wireless communications system determining that said mobile terminal should change cells unless:

10

- i) the current cell provides at least minimally acceptable signal quality to said mobile terminal;
- ii) the current cell is participating in said group call session with another mobile terminal assigned to said current cell; and
- iii) no acceptable candidate cells, not including the current cell, are participating in said group call session;

15

said wireless communications system instructing said mobile terminal to change cells if said wireless communications system determines that said mobile terminal should change cells.

20

18. A method of controlling cell assignment of a wireless communications mobile terminal operating in conjunction with a wireless communications system during an active circuit switched group call, comprising:

storing a list of candidate cells including a current cell at said wireless communications system;

said wireless communications system determining which, if any, of said candidate cells is participating in said group call;

said wireless communications system determining whether said mobile terminal should stay with the current cell or be handed off

to another cell in response to a handoff trigger event, said wireless communications system determining that said mobile terminal should be handed off to another cell unless:

- 5 i) said current cell provides at least minimally acceptable signal quality to said mobile terminal;
- ii) said current cell is participating in said group call with another mobile terminal assigned to said current cell; and
- iii) no acceptable candidate cells, not including said current cell, are participating in said group call;

10 said wireless communications system instructing said mobile terminal to change cells if said wireless communications system determines that said mobile terminal should be handed off to another cell.

15 19. A method of controlling cell assignment of a wireless communications mobile terminal operating in conjunction with a wireless communications system during an active circuit switched group call, comprising:

communicating with said mobile terminal via a first cell during said group call;

20 assigning a greater than normal priority to said mobile terminal and handing off said mobile terminal to a second cell with said greater than normal priority in response to a handoff trigger event during said group call.

20. The method of claim 19 further including said second cell maintaining a queue of channel assignment requests and further including assigning a preferential position in said queue to said handed-off group call.

21. The method of claim 20 further including said second cell maintaining 5 a queue of channel assignment requests and further including assigning the most preferential position in said queue to said handed-off group call.

22. The method of claim 19 further including said second cell maintaining a queue of channel assignment requests and further including allowing said handed-off group call to bypass said queue.

10 23. The method of claim 19 wherein said second cell includes normal and reserve channels and further including allocating said handed-off group call one of said reserve channels.

24. A method of controlling cell assignment of a wireless communications mobile terminal participating in a group call session, comprising:

15 assigning said mobile terminal to a first cell;
storing a list of candidate cells including a second cell;
determining if said second cell is participating in said group call session;
selectively changing the cell assignment of said mobile terminal from
20 said first cell to said second cell based on participation of said first and second cells in said group call session.

25. The method of claim 24 wherein said determining if said second cell is participating in said group call session includes determining which, if any, of said candidate cells is participating in said group call.

26. The method of claim 24 wherein said selectively changing the cell assignment of said mobile terminal includes changing the cell assignment of said mobile terminal from said first cell to said second cell if:

5 said first cell is not participating in said group call session with
 another mobile terminal assigned to said first cell;
 said second cell is participating in said group call session; and
 said second cell provides at least minimally acceptable signal quality
 to said mobile terminal.

27. The method of claim 24 wherein said selectively changing the cell
10 assignment of said mobile terminal includes changing the cell assignment of said
mobile terminal from said first cell to said second cell if:
 said first cell is not participating in said group call session with
 another mobile terminal assigned to said first cell;
 said second cell is participating in said group call session; and
15 said second cell provides signal quality of better than a
 predetermined level to said mobile terminal.

28. The method of claim 24 wherein said mobile terminal is a first mobile
terminal and further including assigning a second mobile terminal to said second
cell prior to said determining if said second cell is participating in said group call
20 session and wherein said selectively changing the cell assignment of said mobile
terminal includes changing the cell assignment of said mobile terminal from said
first cell to said second cell because said second mobile terminal is participating in
said group call session in said second cell.

29. The method of claim 24 wherein said first cell belongs to a wireless communications system and wherein said determining if said second cell is participating in said group call session is performed by said wireless communications system.

5 30. The method of claim 24 wherein selectively changing the cell assignment of said mobile terminal from said first cell to said second cell based on participation of said first and second cells in said group call session includes said mobile terminal controlling said selectively changing the cell assignment of said mobile terminal from said first cell to said second cell based on participation of 10 said first and second cells in said group call session.

31. The method of claim 29 wherein selectively changing the cell assignment of said mobile terminal from said first cell to said second cell based on participation of said first and second cells in said group call session includes said wireless communications system controlling said selectively changing the cell 15 assignment of said mobile terminal from said first cell to said second cell based on participation of said first and second cells in said group call session

32. Cancelled

STATEMENT UNDER ARTICLE 19(1)

Pursuant to Article 19(1) the claims have been amended.

In particular, claims 1 through 8 and 32 have been cancelled to provide a more concise presentation of the claims.

Claims 9 through 31 remain unchanged.

Enclosed please find replacement pages 15 through 23 to replace pages 15 through 25 of the original application.